

Redox Active Layer-by-Layer Structures containing MnO₂ Nanoparticles

Fernanda Bazito, Robert O'Brien, and Daniel A. Buttry*

*University of Wyoming, Department of Chemistry, 1000 E. University Ave., Laramie, Wyoming
82071*

Buttry@uwyo.edu

Nanoscale materials provide unique properties that will enable new technologies and enhance older ones. One area of intense activity in which nanoscale materials are being used is in the development of new functional materials for battery applications. This effort promises superior materials with properties that circumvent many of the problems associated with traditional battery materials. Previously we have worked on several approaches for using nanoscale materials for application as cathode materials in rechargeable Li batteries. Our recent work has focused on synthesizing MnO₂ nanoparticles and using these in layer-by-layer (LbL) structures to probe the redox properties of the nanoparticles. We show that the aqueous colloidal nanoparticles produced by butanol reduction of tetramethylammonium permanganate can be trapped in thin films using a layer-by-layer deposition approach, and that these films are both redox active and exhibit kinetically facile electrochemical responses. We show cyclic voltammetry of MnO₂ colloidal nanoparticles entrapped in a LbL thin film at an ITO electrode surface using poly(diallyldimethylammonium chloride) (PDDA). CV experiments demonstrate that Li⁺ insertion accompanies Mn(IV) reduction in LiClO₄ supporting electrolytes, and that reduction is hindered in supporting electrolytes containing only tetrabutylammonium cations. We also show that electron propagation through multilayer films is facile, suggesting that electrons percolate through the films *via* electron exchange between nanoparticles.